MICROPLANKTON FROM THE AMPTHILL CLAY OF MELTON, SOUTH YORKSHIRE

by W. A. S. SARJEANT

ABSTRACT. Assemblages of organic-shelled microplankton from the Ampthill Clay (Upper Jurassic) of South Yorkshire are described. They comprise twenty-one species of dinoflagellates, of which two are new; twenty-seven species of hystrichospheres, of which three are new; and four species of presumed microplankton *incertae sedis*. From comparison with microplankton assemblages previously described, a stratigraphic position is tentatively assigned to the horizons studied.

THE assemblages of fossil microplankton to be described are from four horizons within the argillaceous facies of the Oxfordian ('Ampthill Clay') exposed in the clay pit of Messrs. G. and T. Earle, Ltd., at Melton, near Kingston-upon-Hull (grid reference S.E. 971268). A first visit was made to this pit during a meeting of the Yorkshire Geological Society on 13 February 1960, and a second visit in the following July, the pit having been considerably deepened between visits. At the time of the second visit, some 62 feet of grey clay were exposed below the unconformable capping of orange sands and Red Chalk (text-fig. 1). Four specimens collected were examined for microplankton, respectively from 61 ft. 7 in., 45 ft. approx., 25 ft., and 10 ft. below the overlying Cretaceous beds (henceforth referred to as the '62-foot', '45-foot', '25-foot', and '10-foot' horizons).

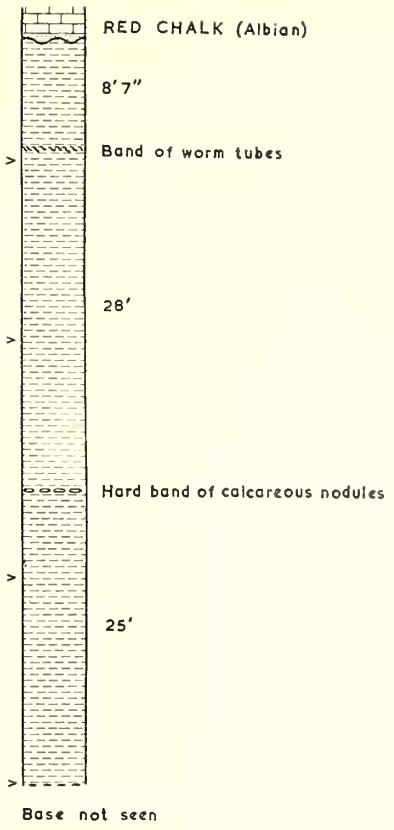
The samples consisted of light-grey clay with yellowish flecks. Each was crushed mechanically and treated successively with hydrochloric and hydrofluoric acids: the resultant organic residue was partially oxidized with Schulze solution and washed with potassium hydroxide solution, thus further concentrating the microfossil content. The product was mounted for study in glycerine jelly.

The proportion of microfossils present proved high at all horizons, their state of preservation being generally excellent. Spores and pollen are present in abundance: at the 62-foot horizon they comprise only 40 per cent., at the 25-foot and 10-foot horizons around 50 per cent., and at the 45-foot horizon fully 70 per cent. of the total microfossil assemblage. Microplankton (dinoflagellates, hystrichospheres, and genera of presumed microplankton) form the remainder of the assemblage, foraminiferal shell linings being also present but only in extremely low numbers.

DISCUSSION OF THE ASSEMBLAGES

The relative proportions of the major microplankton groups are shown in Table 1, and especially noteworthy are the abundance of micrhystridia at the 25-foot horizon and the abundance of leiospheres at this and at the 45-foot horizons. In the assemblages as a whole, dinoflagellates form 42·5 per cent., hystrichospheres 53·4 per cent., and genera *incertae sedis* 4·1 per cent.; the dinoflagellates are numerically dominant only in the uppermost (10-foot) horizon. Twenty-one species of dinoflagellates, twenty-seven species of hystrichospheres, and four species *incertae sedis* were recognized; several

[Palaeontology, Vol. 5, Part 3, 1962, pp. 478–97, pls. 69–70.]



TEXT-FIG. 1. Section through the Ampthill Clay of Messrs. G. & T. Earle's clay pit at Melton, near Hull. The horizons from which assemblages were examined are indicated by arrows.

HORIZONS	% Dinoflagellates	% Hystrichospheres				Microplankton Incertae Sedis
		Larger Forms	Micrhystridia	Leiospheres	Total	
10 — Foot	53·0	25·4	16·2	1·4	43·0	4·0
25 — Foot	39·2	3·6	38·4	13·8	55·8	5·0
45 — Foot	40·8	19·6	10·0	25·6	55·2	4·0
62 — Foot	37·2	37·6	13·8	8·0	59·4	3·4

TABLE 1. The relative proportions of the groups of microplankton in the Melton assemblages.

other species of dinoflagellates are certainly present, each represented by a few poor specimens not suitable for full description. A list of species, with their numerical distribution by horizon, is given in Table 2.

In this section, only new species, or species about which additional information was forthcoming, are dealt with. All holotypes of species described are to be lodged in the Laboratory of Sedimentology, University of Reading.

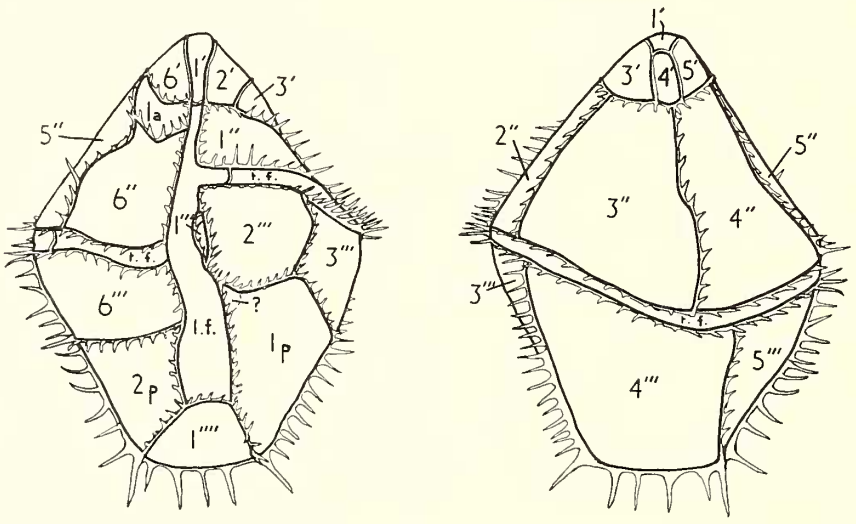
Class DINOPHYCEAE
Order PERIDINIALES
Family GONYAULACIDAE Lindemann
Genus GONYAULAX Diesing

Gonyaulax nealei sp. nov.

Plate 69, fig. 1; text-fig. 2

Holotype. M134/3/172, 62-foot horizon of Ampthill Clay, Melton. *Dimensions of Type.* Overall: length 69 μ, breadth 61 μ. Without spines: length 64 μ, breadth 50 μ. Spines up to 5 μ in length. Other specimens too damaged for satisfactory measurement.

Diagnosis. A species of fossil *Gonyaulax* with epitheca conical, rounded at the apex, and hypotheca in the form of a truncated cone. Tabulation 6′, la, 6″, 6‴, 2p, 1⁗: plate 1″ reduced and elongate. Sutures in the form of low ridges generally bearing simple spines of varying length and quite wide separation: the apical sutures, however, lack spines.



TEXT-FIG. 2. *Gonyaulax nealei* sp. nov. Holotype (M134/3/172), ×900. Left: in ventral view. Right: in dorsal view. *t.f.*, transverse furrow. *l.f.*, longitudinal furrow.

Description. Theca pale yellowish in colour, thin walled and without granulation. There is no apical horn: the six apical plates differ from those of the rest of the theca in that

the sutures between them lack spines, whereas the sutures separating them from the other epithecal plates are spinose. One anterior intercalary plate and six pre-equatorial plates are present: plates 1″ and 6″ are somewhat reduced.

The transverse furrow is of moderate breadth and extends round the theca in a laevo-rotatory spiral such that its two ends differ in antero-posterior position by twice the width of the furrow. The longitudinal furrow is narrow in its epithecal portion but broadens as it approaches the antapex. Of the six post-equatorial plates, plate 1‴ is very reduced and not readily seen, and plates 2‴ and 6‴ are also somewhat reduced. Two large posterior intercalary plates are certainly present: a third (marked '?') may also be present in the angle formed by plate 1p against plate 2‴ and the longitudinal furrow, but this could not be confirmed. The antapical plate is large and polygonal in shape.

The species is named after Dr. J. W. Neale of the Geology Department, University of Hull.

Remarks. Of the six specimens seen, only the holotype is well enough preserved to be capable of full study. In shape, tabulation, and ornamentation of crests, *Gonyaulax nealei* differs from all described fossil species. Those most closely comparable are *Gonyaulax cornigera* Valensi 1953, from the Bathonian of France, and *G. serrata* Cookson and Eisenack 1958, from Upper Jurassic to ?Neocomian of Western Australia. In neither of these species is the tabulation fully known: the former is distinguished by its longer and sometimes bifurcate sutural spines, the latter by the possession of grouped bifurcate processes on the apex.

Gonyaulax paliuros Sarjeant 1962

Plate 69, fig. 2

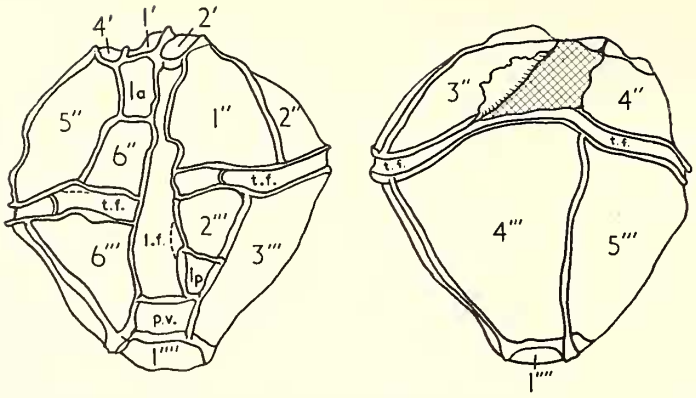
Remarks. This species, originally described from the Oxfordian (Corallian) (Sandsfoot Clay, *E. bimammatum* Zone) of Dorset, is abundant at all four horizons. The tabulation proved, as always, very difficult to determine, but observations made supported the earlier interpretation. This species has also now been found present in the assemblage from the Hambleton Oolite of Filey Brigg, Yorkshire, described earlier (Sarjeant 1960*b*).

Gonyaulax eumorpha Cookson and Eisenack 1960

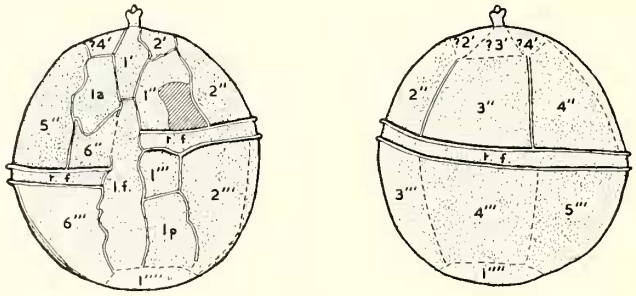
Plate 69, fig. 12; text-fig. 3

Remarks. This species, originally described from Oxfordian to Lower Kimmeridgian and probably Tithonian horizons of Western Australia, is recorded for the first time from Europe, representatives being present at three of the horizons studied.

The figured specimen (M132/8/61A) is the best preserved. Its tabulation corresponds in broad terms to that of the type; there are, however, several differences in detail. The boundary between plates 1a and 6″ is well defined and plate 6″ is clearly larger than plate 1a: in the type, the boundary is poorly defined and plate 1a considered larger. The transverse furrow shows a distinct subdivision by low sutures, a feature not observed in the type: and the posterior ventral plate (p.v.) is squarish and has a clearer relation to the antapical plate. Pre-equatorial plate 3″ is torn open and may well represent an archaeopyle.



TEXT-FIG. 3. *Gonyaulax eumorpha* Cookson and Eisenack. The specimen figured (M132/8/61a) differs from the type description in detail of tabulation. Left: in ventral view. Right: in dorsal view. ×600.



TEXT-FIG. 4. *Gonyaulax nuciformis* (Deflandre) comb. nov. Ventral tabulation (left) from specimen M134/1/37; dorsal tabulation (right) diagrammatic, reconstructed from several specimens studied. ×600.

Gonyaulax nuciformis (Deflandre) comb. nov.

Plate 69, fig. 6; text-fig. 4

1938 *Palaeoperidinium nuciforme* Deflandre, p. 180, pl. viii, figs. 4–6.

Diagnosis. A species of fossil *Gonyaulax* having a spheroidal to ovoidal theca, thick walled and very coarsely granular, the granules in some cases so large as to be better regarded as very short spines. Tabulation ?4′, 1a, 6″, 6‴, 1p, 1⁗: extremely difficult to determine, since the sutural crests are very low and masked by the surface ornament. The apical process is short and broad, bifurcating briefly distally and giving rise to a short terminal process.

Remarks. This species was originally attributed to the genus *Palaeoperidinium* in absence of knowledge of the tabulation. In course of a recent visit to the Laboratoire de Micropaléontologie in Paris, I was courteously allowed by Prof. Deflandre to examine the holotype, which gives indication of a tabulation but no more. The species is present in the Middle Callovian of Dorset (Sarjeant 1962) and it occurs at all four Melton

Species of microplankton \ Horizon within the Ampthill Clay of Melton	62 — foot M134	45 — foot M131	25 — foot M133	10 — foot M132
Gonyaulax jurassica Deflandre	31	17	16	49
G. cladophara Deflandre	3	13	17	49
G. eisenacki Deflandre	15	11	4	9
G. ambigua Deflandre	4	5	9	7
G. paliuros Sarjeant	19	9	29	12
G. acanthosphaera Sarjeant	9	—	11	14
G. eumorpha Cooksan & Eisenack	4	3	—	3
G. nuciformis (Deflandre) camb. nov.	25	9	2	18
G. pachyderma Deflandre	2	—	—	—

Species of microplankton \ Horizon within the Ampthill Clay of Melton	62 — foot M134	45 — foot M131	25 — foot M133	10 — foot M132
Gonyaulax turgescica Deflandre	31	17	16	49
G. cladophora Deflandre	3	13	17	49
G. eisenacki Deflandre	15	11	4	9
G. ambigua Deflandre	4	5	9	7
G. pollucra Sarjeant	19	9	29	12
G. acanthosphaera Sarjeant	9	—	11	14
G. eumorpha Cookson & Eisenack	4	3	—	3
G. nuciformis (Deflandre) comb. nov.	25	9	2	18
G. pachyderma Deflandre	2	—	—	—
G. negeli sp. nov.	1	5	—	—
Pluriarvalium gemingtonense Sarjeant	—	—	1	—
Cleistosphaeridium ornatum Deflandre	1	2	—	1
Cf. Palaeohystrichophora spinosissima (Defl.)	1	—	—	—
Pareodinia ceratophora Deflandre	12	21	12	9
Scriniodinium crystallinum (Deflandre)	12	14	35	75
S. luridum Deflandre	2	11	3	7
S. galeritum Deflandre	3	13	9	—
S. subvallare Sarjeant	3	7	—	—
S. oxfordianum sp. nov.	—	7	5	2
S. dictyotum Cookson & Eisenack	6	12	4	10
Nannoceratopsis pellucida Deflandre	3	18	—	1
Hystrichosphaera furcata (Ehrenberg)	—	2	—	—
Hystrichosphaeridium salpingophorum (Defl.)	2	7	—	—
Baltisphaeridium pilosum (Ehrenberg)	51	8	—	11
B. clavuliferum (Deflandre)	47	3	10	19
B. vestitum (Deflandre)	23	12	1	34
B. ehrenbergi (Deflandre)	19	15	—	11
B. tribuliferum sp. nov.	3	4	—	6
B. polytrichum (Valensi)	5	15	—	—
B. parvispinum (Deflandre)	—	—	—	4
Baltisphaeridium sp.	1	—	—	—
Cannosphaeropsis cauliceryi Deflandre	22	3	1	14
Systematophora orbifera Klement	1	1	—	—
Dictyopyxis areolata Cookson & Eisenack	2	3	—	—
Chlamydophorella wallala Cookson & Eisenack	—	—	—	4
Cymatiosphaera parva Sarjeant	—	—	3	2
Pterospermopsichellas Sarjeant	—	1	2	8
P. cf. heliae Sarjeant	—	—	—	1
Micrhystridium inconspicuum (Deflandre)	17	30	114	62
M. fragile Deflandre	33	14	14	8
M. recurvatum Valensi	7	5	?	—
M. stellatum Deflandre	8	1	—	4
M. rhopalicum sp. nov.	2	?	6	9
M. rarispinum Sarjeant	—	2	19	—
M. sydus Valensi	—	—	10	—
M. cf. piveteavi Valensi	1	—	—	—
M. deflandrei Valensi	—	—	3	—
Leiosphaeridia simillis Cookson & Eisenack	—	—	6	4
L. chytraeidea sp. nov.	40	128	32	3
L. sp.	—	—	25	—
Palaeostomocystis sinuata Cook. & Eis.	—	—	2	—
Stephanelytron scarburghense Sarjeant	7	4	1	1
S. redcliffense Sarjeant	7	7	21	20
Netrelytron elegatum Sarjeant	6	10	—	3

TABLE 2. List of microplankton species present in the Melton assemblages, showing numerical distribution by horizon.

LOCATION / STAGE NAME (with ammonite zones) / SPECIES OF MICROPLANKTON	France	France	England (North Yorkshire and Dorset)													FRANCE		Malm S.W. Germany		Australasia			England		England (Melton, S. Yorks)			
			CALLOVIAN			OXFORDIAN																		Ampthill Clay			
	BAJOCIAN	BATHONIAN	M. macrocephalus	S. calloviense	K. jason	E. coronatum-P. athleta-K. lamberti	LOWER Q. mariae	UPPER Q. mariae	LOWER C. cordatum	UPPER C. cordatum	P. plicatilis	E. bimammatum	OXFORDIAN (C. cordatum)	LOWER KIMMERIDGIAN	OXFORDIAN	LOWER KIMMERIDGIAN	OXFORDIAN	L. KIMMERIDGIAN	M.-U. KIMMERIDGIAN	U. KIMMERIDGIAN	POST-KIMMERIDGIAN	62 feet	45 feet	25 feet	10 feet
Gonyaulax cladophora	X	X		X	X	X	X	X	X	X	X	X	X			X	X	?				X	X	X	X
G. jurassica		X		X	X	X	X	X	X	X	X	X	X			X	X	?				X	X	X	X
G. caytonense			X																						
G. cristulata			X																						
G. transparens			X																						
G. eisenacki					X	D					X		X			X						X	X	X	X
G. ambigua					X						X			X							X	X	X	X	X
G. nuciformis					X	E							X									X	X	X	X
G. arealata							X	X	X																
G. acanthosphaera						N	X		X		X											X	o	X	X
G. paliuros										X		X										X	X	X	X
G. pachyderma						I						X	X									X			
G. nodei																						X	X		
G. cumorpha						A												X	X	?		X	X	a	X
Ctenidodinium ornatum									?	X			X				X					X	X	a	X
Piurlarvalium asmingtonense						T						X										·		X	
Palaeahystrichaphara spinosissima									cf.	cf.			X									cf.			
Palaeoperidinium dictyopharum										X			X												
Pareadinia prolongata			X			B																			
P. ceratophora	X		var.		X	O	var.	X	X	X	X	X										X	X	X	X
Nannoceratopsis pellucida									X				X					X	X	?		X	X	a	X
Scriniodinium luridum					X		X	X	X	X	X		X	X		X		X	?			X	X	X	X
S. crystallinum							X	X	X	X	X		X			X	?	X				X	X	X	X
S. galeritum								X		X			X			X	?					X	X	X	
S. dictyatum												X						X	X			X	X	X	X
S. subvallare											X											X	X		
S. oxfordianum						I				X		X											X	X	X
Hystrichosphaera furcata												X	X								X		X		
Hystrichosphaeridium salpingophorum						E	X	X		X	X	X	X			X					X	X	X		
H. cribrotubiferum										X															
Cannosphaeropsis filamentasa			X			Y										X		X							
C. cauleryi				X	X		X	X	X	X	X	X	X							X		X	X	X	X
C. aemula								X	X	X						X									
Systematophara arbifera																X							X		
S. valensii											X														
Palystephanepharus paracalathus					X																				
P. calathus						I	X																		
Baltisphaeridium stimuliferum	X	X				O	X	X	X	X			X									X	X	X	X
B. varispinosum			X			C																			
B. cf. fimbriatum					X		X	X																	
B. pilosum						N	X	X	X	X												X	X	o	X
B. vestitum										X	X	X	X									X	X	X	X
B. ehrenbergi							X	X		X												X	X	a	X
B. tribuliferum							X	X	X	X			?									X	X	a	X
B. polytrichum			X				X	X			X											X	X		
B. parvispinum						S															X				X
B. granulosum												X								X					
B. lumectum						E						X													
Micrhystridium inconspicuum	X	X	X	X	X		X	X	X	X	X	X									X	X	X	X	X
M. fragile	X	X	X	X	X			X	X	X	X											X	X	X	X
M. stellatum	X		X	X		C	X	X	X		X											X	X	a	X
M. recurvatum	X	X				A	X	X	X	X	X	X										X	X	?	
M. sydus		X			·					X	X													X	
M. deflandrei						L				X													·	X	
M. cf. mendax							X																		
M. rarispinum						B				X													X	X	
M. tetraxis										X										·					
M. rhopalicum						M																X	X	X	X
Membranilarnax avulum	X	X		X	X		X															X	X	X	X
Cymatiasphaera parva			X	X		E																		X	X
C. teichophera							X																		
Pterospermopsis helias				X	X	S				cf													X	X	X
P. hartii												X													
Dictyopyxis areolata																	X	X				X	X		
Leiosphaeridia chytroides						S																X	X	X	X
L. similis																			?					X	X
Antrosphaera calloviensis				X		A																			
Wanaea fimbriata							X	X																	
Stephanelytron scarburghense							X															X	X	X	X
S. caytonense							X																		
S. redcliffense								X		X												X	X	X	X
Netrelytron stegastum								X														X	X	o	X
Paleocastomocystis sinuosa																			?					X	

TABLE 3. Known distribution by horizon of microplankton species in British Callovian and Oxfordian assemblages described to date, compared with the known distribution of these species at other localities and horizons. (Distribution of species in the Bajocian and Bathonian of France based on Deflandre 1947, Valensi 1953; in the Oxfordian and L. Kimmeridgian of France, on Deflandre 1938, 1941; in the German Malm, on Klement 1960: in the Upper Jurassic of Australasia, on Cookson and Eisenack 1958, 1960: in the Upper Kimmeridgian of England, on Downie 1957: and in post-Kimmeridgian sediments, on Deflandre 1934, 1937, O. Wetzel 1933, &c.)

horizons: the majority of its representatives, like the type, show only traces of a tabulation, the thick walls, dark yellowish-brown colour and heavy granulation making study difficult. One specimen, however (M134/1/37), in which the dorsal surface is almost entirely lacking, allowed determination of details of the ventral tabulation, and indications on several other specimens enabled reconstruction of the dorsal tabulation. The species is clearly attributable to the genus *Gonyaulax* and resembles, in tabulation, the thickness and granular nature of its walls, and the possession of a short apical horn, the species *G. pachyderma* Deflandre of the French Lower Oxfordian (1938), differing from the latter in the shape of the apical horn, details of plate shape, and the presence of an anterior intercalary plate. A close systematic relationship between the two species is clearly indicated; *G. nuciformis* is known to occur earlier than *G. pachyderma* and might be visualized as giving rise to the latter species by loss of plate 1a, simplification of horn structure and emphasis of sutural crests. However, no intermediate forms are known to date. The range of dimensions exhibited (Melton specimens) is overall length 56–58 μ, breadth 50–64 μ: the specimens are more generally spheroidal than those whose dimensions are quoted by Deflandre (length 60–65 μ: breadth 47–53 μ).

Family HYSTRICHODINIDAE
Genus PALAEOHYSTRICHOPHORA Deflandre, 1934 (emend. Deflandre and Cookson, 1955)

Cf. *Palaeohystrichophora spinosissima* (Deflandre 1938)

Remarks. A single specimen from the 62-foot horizon accords well with forms described under this name from North Yorkshire (Sarjeant 1960). The tabulation again proved incapable of determination.

?Order GYMNODINIALES
Family uncertain
Genus PAREODINIA Deflandre

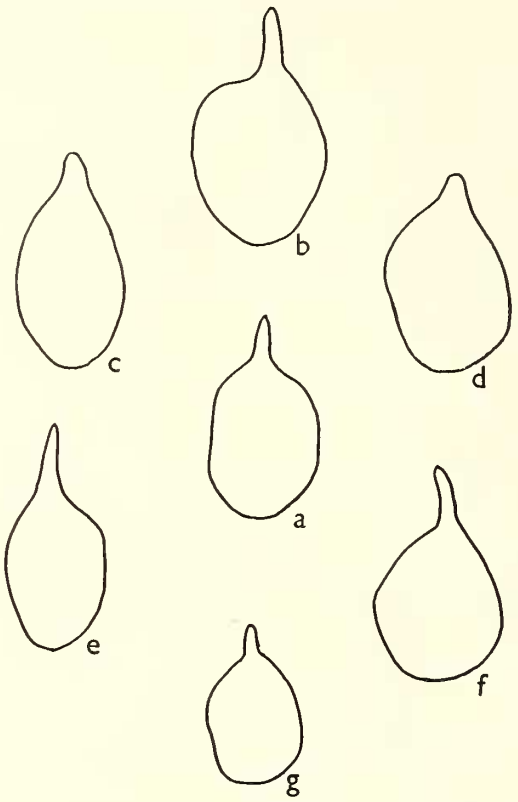
Pareodinia ceratophora Deflandre, 1947

Plate 69, fig. 8; text-fig. 5

Remarks. This species was originally described from the Callovian of the Baltic region and Bajocian of France (1947). It has subsequently been found represented, in its typical form, in British strata ranging in age from Middle Callovian to Upper Oxfordian (Lantz 1958, Sarjeant 1960, 1961, 1962) and a variety, *P. ceratophora* var. *pachyceras* Sarjeant, in the Lower Callovian and lowest Oxfordian (1959 and 1961).

This species is of extremely variable form, variation occurring in overall size, in granularity, in ratio of length to breadth, in shape of the apical horn, and in ratio of horn length to overall length. The variation in all characters save granularity is shown in text-fig. 5, where the outlines of individuals, drawn to a constant scale, are shown in pictogram form (variation in granularity proved independent of these dimensional variations). All intermediates between the figured extremes are known. Within the Melton assemblage, a very wide variation of form was observed, the variations typified by specimens in text-fig. 5 *b*, *c*, being especially frequent. The latter is indistinguishable in outline from the forms classed previously (1959) as var. *pachyceras*, differing only in

the less strongly coloured and more granular nature of the shell. *Pareodinia aphelia* Cookson and Eisenack 1958, from the Upper Jurassic and Lower Cretaceous of Western Australia, is known to vary in proportions in similar fashion to *P. ceratophora*, although the proportion of horn length to body length is generally smaller. It is probable

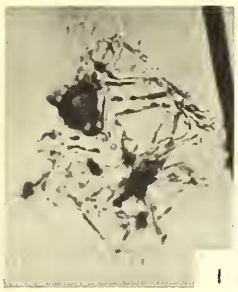


TEXT-FIG. 5. The range of variation exhibited by *Pareodinia ceratophora* Deflandre. Outlines of specimens from several horizons, drawn to a constant scale. *a*, CB81/6/4, from the Oxford Clay of Cayton Bay, Yorkshire. *b*, *c*, *f*. M134/1/92, M133/4/14, and M134/4/66, from the Ampthill Clay of Melton. *d*, *e*, WC90/14/5 and WC90/1/1, from the Oxford Clay of Chickerell, Dorset. *g*, O130/9/2, from the Osmington Oolite of Osmington Mills, Dorset. All ×375.

EXPLANATION OF PLATE 69

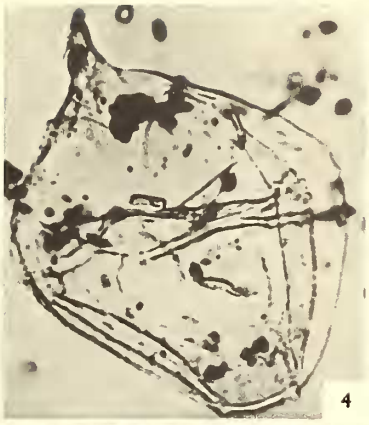
Microplankton from the Ampthill Clay of Melton, near Hull, Yorkshire. All figures ×c. 500.

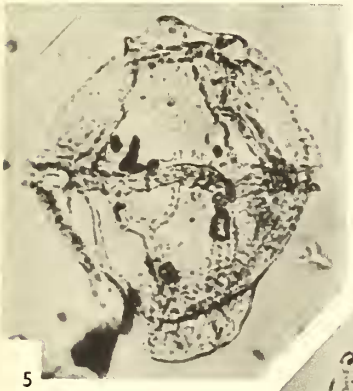
1, *Gonyaulax nealei* sp. nov., M134/3/172, holotype, ventral view. 2, *G. paliuros* Sarjeant, M133/2/24, ventral view. 3, *G. eisenacki* Deflandre, M134/1/71, lateral view. 4, *Pluriarvalium osmingtonense* Sarjeant, M133/5/13, dorsal view. 5, *Scriniodinium subvallare* Sarjeant, M134/3/132, ventral view. 6, *G. nuciformis* (Deflandre) comb. nov., M134/1/37, ventral view (interior view of half-shell). 7, *S. luridum* (Deflandre), M134/2/131. 8, *Pareodinia ceratophora* Deflandre, M134/1/92. 9, 10, *Nannoceratopsis pellucida* Deflandre, M132/8/18A, M134/4/64. 11, *S. dictyotum* Cookson and Eisenack, M132/8/88A. 12, *G. eumorpha* Cookson and Eisenack, M132/8/61A. 13, 14, *S. oxfordianum* sp. nov. 13, M131/1/58. 14, holotype, FB122/11/34 Hambleton Oolite, Carr Naze, Filey Brigg, Yorks.

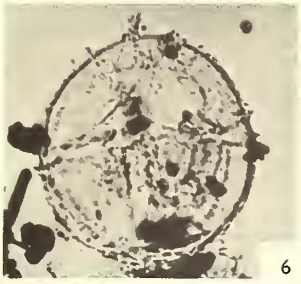

1


2


3


4


5


6

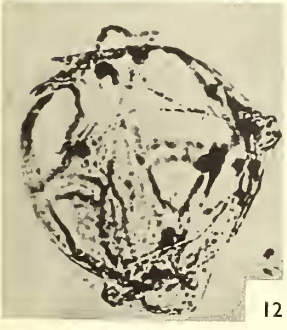

7

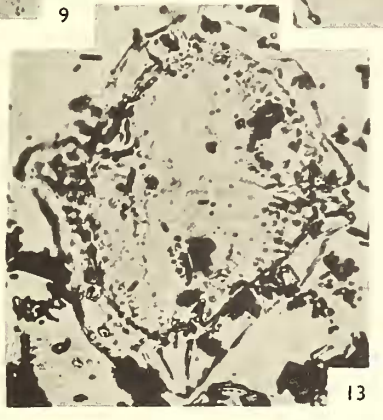

8

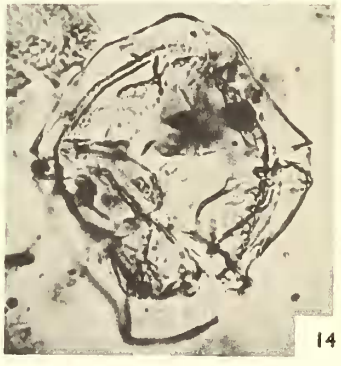

9


10


11


12


13


14

SARJEANT, Oxfordian microplankton

that both species are part of one continuous plexus and that the systematic distinction between them is wholly artificial.

Order Uncertain
Family DEFLANDREIDAE
Genus SCRINIODINIUM Klement
Subgenus ENDOSCRINIUM Klement 1960

Scriniodinium (?*Endoscrinium*) *oxfordianum* sp. nov.

Plate 69, figs. 13, 14

1960 Scriniodinium sp. A Sarjeant, p. 394, pl. 13, fig. 2.
1962 *Scriniodinium* (?*Endoscrinium*) sp. Sarjeant, p. 263, pl. 1, fig. 15.

Holotype. FB122/11/34, Hambleton Oolite (10 feet below top), Carr Naze, Filey Brigg. *Dimensions of type.* Cyst length 100 μ, breadth 82 μ. Theca length 82 μ, breadth 62 μ.

Diagnosis. A species of *Scriniodinium* having a cyst of broadly ellipsoidal shape, one face of whose hypothecal portion is somewhat flattened. Theca ellipsoidal, having a distinct tabulation, apparently 4′, 6″, 5‴, 0p, 0⁗; the sutures of the ventral surface are unornamented, but sutures elsewhere bear raised crests formed by short spines, quite widely separated, whose tips are linked by a trabecula following the course of the suture.

Description. The cyst is ellipsoidal, pale yellowish or yellowish-brown in colour, smooth or very faintly granular. In some specimens there is a distinct equatorial bulge, the shape thus becoming biconical rather than ellipsoidal; in others, the space between theca and cyst is larger at one pole than at the other. The theca is somewhat darker in colour and broadly ellipsoidal in shape. Its surface may be areolate in patches; these patches are quite irregular in position and their distribution varies between individuals, the areolation being in all cases most pronounced near to a suture and dying out toward the centre of the plate.

The characteristic features of this species are its distinctive sutural crests, composed of widely spaced spines linked in T-fashion by a trabecula. The sutures of the ventral surface lack such crests, being marked only by low ridges, extremely hard to see even under the most favourable conditions: orientation and the establishment of a tabulation are thus difficult. From the examination of all available specimens, the tabulation was considered to resemble that established by Klement for his subgenus *Endoscrinium*, with four apical plates definitely present. The transverse furrow is of moderate breadth and only feebly laevo-rotatory, the longitudinal furrow narrow in its epithecal portion but broadening as it approaches the antapex. All specimens examined show some degree of damage, but the presence in constant position of an archaeopyle cannot be affirmed.

Remarks. Following study of the Melton specimens of *Scriniodinium oxfordianum*, representatives of this genus in the Yorkshire Corallian horizons were re-examined and the earlier interpretation of the crests of *Scriniodinium* sp. A (1960) corrected: these are as here described, and not 'perforated and in part areolate', as stated earlier. Indeed, specimen FB122/11/34 shows the form of the crests more clearly than any other seen;

for this reason, it has been chosen as type despite its damaged condition. The specimens from the Ringstead Waxy Clay (*E. bimammatum* Zone) of Dorset, earlier attributed to an undescribed species of *Scriniodinium* (1962), fall clearly within the range of variation of this species. The Melton specimens are generally somewhat larger than the type; specimen M131/1/58 (figured) has cyst 124 μ × 107·5 μ and theca 98·5 μ × 75·5 μ.

Scriniodinium oxfordianum may represent an intermediate stage between species without a recognizable tabulation, such as the type species of the genus, *Scriniodinium* (*S.*) *crystallinum* (Deflandre) and clearly tabulate species, such as *S.* (*Endoscrinium*) *luridum*. In *S. oxfordianum*, the sutures of the ventral surface are poorly defined; in *S. crystallinum*, the transverse furrow cannot be traced across this surface and no longitudinal furrow is apparent. The flattening of one face of the hypothecal portion of the cyst of *S. oxfordianum* may be regarded as an approach to the projecting membraneous 'cross-arching' of *S. luridum:* and the tabulation of the two species appears similar. In some poorly preserved specimens from Melton, there appears to be incomplete development of crests on sutures near the apex; these specimens could not be definitely attributed either to *S. crystallinum* or to *S. oxfordianum* and may well represent an intermediate stage of progressive crest development, leading from the former to the latter species. A process of filling in of the crests and modification of general shape might lead from *S. oxfordianum* to *S. luridum*. The forms from the Upper Calcareous Grit of Yorkshire, described as *Scriniodinium* sp. B (1960*b*) are similar in general shape to *S. luridum* but have crests of the type of *S. oxfordianum:* however, they occur in an assemblage in which the typical forms of these species are not present. Apparent intermediates of this character are not known from earlier horizons, and this second line of possible evolutionary development remains hypothetical.

Order HYSTRICHOSPHAERIDIA

Family HYSTRICHOSPHAERIDAE

Genus HYSTRICHOSPHAERA O. Wetzel 1933

Hystrichosphaera furcata (Ehrenberg 1838) O. Wetzel 1933

Remarks. The occurrences of this species in the Upper Jurassic, of which the Melton record is the third, are of interest in relation to the controversy with regard to the definition of this species and of *H. ramosa* (Ehrenberg 1838) O. Wetzel 1933. In the Upper Cretaceous, the two species form a continuously varying plexus (Lejeune-Carpentier 1937*a*, *b*); *H. ramosa* has not to date been recorded earlier. It appears that *H. furcata* is, as would be expected, the ancestral type and that the trend of increase in complexity of the spines, leading to *H. ramosa*, did not begin to operate until well into the Cretaceous.

Genus BALTISPHAERIDIUM Eisenack 1958

Baltisphaeridium ehrenbergi (Deflandre 1947) Sarjeant 1961

Plate 70, fig. 1; text-fig. 6*a*

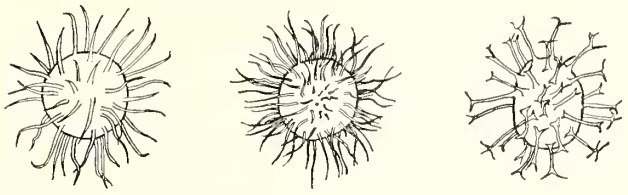
Remarks. This species, originally described from the Lower Oxfordian of Normandy, is present in three Melton assemblages. It has also now been noted from three horizons in the Yorkshire Oxford Clay (from the base, in the exposures in Scarborough Castle

Cliff: and from horizons respectively 25 feet and *c.* 100 feet above the base, in High Red Cliff, Cayton Bay; all within the *Q. mariae* Zone) and from the Hambleton Oolite of Filey Brigg, Yorkshire (*C. cordatum* Zone). These are the first British records of this species.

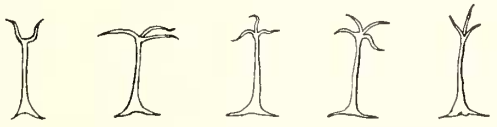
Baltisphaeridium polytrichum (Valensi 1947) Sarjeant 1960*a*

Plate 70, fig. 2; text-figs. 6*b*

Remarks. This species, originally described from the Bathonian of France, is present in the two lower Melton horizons and is also present in the Yorkshire Oxford Clay (lowest and 25-foot horizons: see above) and in the Osmington Oolite of Filey Brigg, Yorkshire (*P. plicatilis* Zone). These occurrences represent a considerable extension of the known range of this species within the Jurassic. A morphologically similar form from the Australian Upper Cretaceous has been placed in this species (Deflandre and Cookson 1955), but the stratigraphic separation remains immense. The forms from the Upper Kimmeridgian of Dorset, attributed to this species by Downie (1957), show clear morphological differences (Sarjeant 1960*a*).



TEXT-FIG. 6. Hystrichospheres from the Ampthill Clay. *a*, *Baltisphaeridium ehrenbergi* (Deflandre) (M134/4/60). *b*, *B. polytrichum* (Valensi) (M134/3/67). *c*, *B. tribuliferum* sp. nov. Holotype, M134/2/29. *All* ×900.



TEXT-FIG. 7. Variation in the form of spines of *Baltisphaeridium tribuliferum* sp. nov. Holotype, M134/2/29; ×*c.* 1,800.

Baltisphaeridium tribuliferum sp. nov.

Plate 70, fig. 4; text-figs. 6*c*, 7

Holotype. M134/2/29, 62-foot horizon of Ampthill Clay, Melton.

Dimensions of type. Overall: long diameter 59 μ, short diameter 54 μ. Shell: long diameter 33 μ, short diameter 25·5 μ. *Range of dimensions.* Overall: long diameters 53–62 μ, short diameters 48–58 μ.

Diagnosis. A species of *Baltisphaeridium* having an ovoid shell bearing widely spaced processes, attached proximally by root-like extensions on the shell surface and tapering somewhat distally, branching at a constant distance from the shell surface into bi-, tri-, or quadri-furcations of variable length and attitude.

Description. Shell smooth, without granulation or punctation, varying in hue from